WOLLASTONITE

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Wollastonite was mined by two companies in the United States in 2005. While mine production is withheld to avoid revealing company proprietary data, industry experts estimate U.S. production to be between 115,000 and 127,000 metric tons per year (t/yr). In 2005, exports of wollastonite were estimated to be less than 10,000 metric tons (t) and imports were estimated to be between 5,500 and 6,500 t. World sales of refined wollastonite products were estimated to be in the range of 500,000 to 550,000 t.

Wollastonite, a calcium metasilicate ($CaSiO_3$), has an ideal composition of 48.3% calcium oxide and 51.7% silicon dioxide but may contain trace to minor amounts of aluminum, iron, magnesium, manganese, potassium, and sodium. It occurs as prismatic crystals that break into massive-to-acicular fragments. Acicular fragments are desirable for filler and extender applications because the long, thin particles improve the flexural modulus, sag resistance, flexural and tensile strengths, and thixotropic properties of the paints, plastics, and rubber products in which they are used. Wollastonite is usually white but also may be gray, brown, or red depending on its composition and grain size. Most commercially mined wollastonite is white in color to meet customers' specifications.

Wollastonite forms when impure limestones are metamorphosed (subjected to heat and pressure) or silica-bearing fluids are introduced into calcareous sediments during metamorphism. In both cases, calcite reacts with silica to produce wollastonite and carbon dioxide. Wollastonite also can crystallize directly from a magma that has high carbon content, but this is a less common occurrence. Deposits of wollastonite have been found in Arizona, California, Idaho, Nevada, New Mexico, New York, and Utah. These deposits also may contain calcite, diopside, garnet, idocrase, and quartz as minor components. New York is the only State where large-scale wollastonite mining has taken place.

Wollastonite is used primarily in ceramics, friction products (primarily automobile brakes), metallurgy, paint, and plastics. Some of the properties that make it so useful are its high brightness and whiteness, low moisture and oil absorption, low volatile content, and the acicular nature of some wollastonite.

Production

Wollastonite has been mined commercially in California and New York. The California deposits, which are in Inyo, Kern, and Riverside Counties, were mined between 1930 and 1970. These operations were limited in size, producing only a few thousand metric tons per year for ceramics, decorative stone, paint, and mineral wool production before closing.

Wollastonite deposits in New York have been mined for more than 50 years. Two companies mined wollastonite in 2005—NYCO Minerals Inc. (a subsidiary of Fording Canadian Coal Trust), which operated mines in Essex County, and R.T. Vanderbilt Co. Inc., which operated a mine in Lewis County. The NYCO deposit contains wollastonite, garnet, and diopside. Parts of the deposit contain up to 60% wollastonite. The ore is processed at the Willsboro, NY, plant, where the garnet is removed by using high-intensity magnetic separators. NYCO also chemically modifies the surfaces of some of its wollastonite products to improve their performance. The R.T. Vanderbilt deposit consists primarily of wollastonite as well as minor amounts of calcite and prehnite and trace amounts of diopside. The ore is processed at R.T. Vanderbilt's St. Lawrence County plant, where it is milled and air classified. R.T. Vanderbilt also produces some surface-treated products.

In 2005, domestic wollastonite production increased from that of 2004. Data collected by the U.S. Geological Survey (USGS) are withheld to avoid disclosing proprietary information. Hawley (2004) estimated U.S. wollastonite production to be between 115,000 and 127,000 t/yr.

Consumption

The USGS does not collect end use data on wollastonite, but market estimates occasionally are published in trade journals. Plastics were believed to have accounted for an estimated 37% of U.S. sales, followed by ceramics (28%), metallurgical applications (10%), paint (10%), friction products (9%), and miscellaneous (6%) in 1999 (Industrial Minerals, 1999). In 2001, ceramic applications were thought to account for 40% to 50% of wollastonite sales worldwide, followed by polymers (20% to 25% of sales), and coatings (10% to 15% of sales). The remaining sales were for construction, friction products, and metallurgical applications (Kendall, 2001).

In ceramics, wollastonite decreases shrinkage and gas evolution during firing, increases green and fired strength, maintains its brightness during firing, permits fast firing, and reduces crazing, cracking, and glaze defects. In metallurgical applications, wollastonite serves as a flux for welding, a source for calcium oxide, a slag conditioner, and to protect the surface of molten metal during the continuous casting of steel. As an additive in paint, it improves the durability of the paint film, acts as a pH buffer, improves its resistance to weathering, reduces gloss, reduces pigment consumption, and acts as a flatting and suspending agent. In plastics, it improves tensile and flexural strength, reduces resin consumption, and improves thermal and dimensional stability at elevated temperatures. Surface treatments are used to improve the adhesion between the wollastonite and the polymers to which it is added. As a substitute for asbestos in floor tiles, friction products, insulating board and panels, paint, plastics, and roofing products, wollastonite is resistant to chemical attack, inert, stable at high temperatures, and improves flexural and tensile strength (Roskill Information Services Ltd., 1996, p. 58-59, 78-81, 104-107, 119, 123-128).

NYCO indicated that sales in 2005 from its operations in Mexico and the United States were 90,000 t valued at $34.9 million compared with 82,000 t valued at $34.8 million in 2004 (Fording Canadian Coal Trust, 2006, p. 5).

Prices

Prices for wollastonite ranged from $50 to $60 per metric ton for Chinese powder to $1,700 per ton for ultrafine surface-treated wollastonite (Hawley, 2004). Prices for domestically produced acicular wollastonite, ex works, were $205 per ton for 200-mesh, $248 per ton for 325-mesh, and $275 per ton for 400-mesh. The price, ex works, for acicular, high-aspect-ratio wollastonite was $345 per ton. Prices for wollastonite from China, free on board (f.o.b.), in bulk, were $80 to $100 per ton for 200-mesh and $90 to $110 per ton for 325-mesh (Industrial Minerals, 2005a). Quoted prices should be used only as a guideline because actual prices depend on the terms of the contract between the seller and the buyer.

Foreign Trade

Comprehensive trade data were not available for wollastonite. Exports were estimated to be less than 10,000 t in 2005. Imports were estimated to be between 5,500 and 6,500 t in 2005. The United States imported 4,630 t from China, 744 t from India, 77 t from Finland, 75 t from Mexico, 19 t from Spain, and 18 t from Canada, based on data from the Journal of Commerce Port Import/Export Reporting Service. Additional amounts of wollastonite probably were imported from or transshipped through Canada and Mexico.

World Industry Structure

World production of crude wollastonite ore probably exceeded 600,000 t in 2005 but sales of refined wollastonite products were thought to be in the range of 500,000 to 550,000 t.

China was the leading producer of wollastonite with an estimated production of 395,000 t and exports of 190,000 t (Industrial Minerals, 2005b). The next leading producer was India with 169,000 t of production in 2005, almost unchanged from 176,000 t in 2003 (Department of Mines and Geology, 2005§[1]). India was followed by the United States (estimated to be 115,000 to 127,000 t/yr). Production in Mexico was estimated to be 27,100 t in 2005, a decline from 28,200 t in 2004 (Secretaria de Economia, 2005§). Production in Finland was 16,800 t in 2004, a decline from 17,400 t in 2002 (Geological Survey of Finland, 2005§). Small amounts of wollastonite probably were produced in other countries.

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China.—S&B Industrial Minerals SA and Quarzwerke GmbH formed a joint venture with a Chinese partner. The venture, Orykton, will mine and process wollastonite in Liaoning Province. Output will include high-value acicular grades for domestic use and export (Industrial Minerals, 2005b).

Outlook

North American wollastonite producers continue to place greater emphasis on sales of higher value acicular and surface-treated products. The most promising growth area for domestic producers continues to be in plastics. Sales of wollastonite for friction product and automotive plastic applications probably will increase slightly based on the strength of the automobile sales. Sales to ceramics, paint, and steel markets are expected to remain unchanged. Imports of wollastonite also may decline slightly because of increased prices for Chinese wollastonite and the increased cost of transportation from China. China has been the major source of lower value wollastonite grades imported into the United States during the past few years. Worldwide consumption probably will increase slowly as consuming markets expand in response to population growth.

References Cited

Fording Canadian Coal Trust, 2006, Fording achieves strong 2005 fourth quarter results: Calgary, Alberta, Canada, Fording Canadian Coal Trust news release, February 2, 21 p.

Hawley, G.C., 2004, Wollastonite: Mining Engineering, v. 56, no. 6, June, p. 52-54.

Industrial Minerals, 1999, Wollastonite: Industrial Minerals, no. 379, April, p. 19.

Industrial Minerals, 2005a, Prices: Industrial Minerals, no. 459, December, p. 71.

Industrial Minerals, 2005b, S&B and Quarzwerke in Chinese wollastonite venture: Industrial Minerals, no. 459, December, p. 12.

Kendall, Thomas, 2001, Wollastonite review: Industrial Minerals, no. 411, December, p. 63-67.

Roskill Information Services Ltd., 1996, The economics of wollastonite (6th ed.): London, United Kingdom, Roskill Information Services Ltd., 131 p.

Internet References Cited

Department of Mines and Geology [India], 2005, Production of major and minor minerals, accessed March 8, 2006, at URL http://www.dmg-raj.com/dmg_whyrajasthan.htm.

[1]References that include a section mark (§) are found in the Internet References Cited section.

Geological Survey of Finland, 2005 (November 30), Industrial minerals and rocks, accessed March 8, 2006, at URL http://www.gsf.fi/explor/eco_indust.htm.
Secretaria de Economia, 2005 (March), Mining-metallurgical Mexican production 2000–2005, accessed March 29, 2006, at URL http://www.economia.gob.mx/index.jsp?P=1023&NLang=en.

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Pigments and Fillers. Ch. in United States Mineral Resources, Professional Paper 820, 1973.
Wollastonite—A Versatile Industrial Mineral. Fact Sheet FS-002-01, 2001.

Other

American Ceramic Society.
Andrews, P.R.A., 1993, Wollastonite: Ottawa, Ontario, Canada, Energy, Mines and Resources Canada Summary Report No. 18, 26 p.
Ceramic Industry, monthly.
Chemical Market Reporter, weekly.
Minerals Pricewatch, monthly.
Mining Engineering, monthly.
Mining Journal, monthly.
Paint and Coatings Industry, monthly.